

CLAIMS

Having thus described the invention, what is claimed is:

1. A spinal plate assembly, comprising:

- (a) a spinal plate, said spinal plate comprising a top surface, a bottom surface opposite the top surface, the bottom surface being suitable for being positioned adjacent bone structure of a recipient user, and a plurality of bone-fastener-receiving apertures, said spinal plate further comprising a length and a width, and a thickness between the top surface and the bottom surface, channel structure extending alongside respective ones of the apertures, said channel structure comprising at least one channel having a collective length, and first and second sides, at least one of the first and second sides of the at least one channel having an opening therein extending into a respective said one of the fastener-receiving apertures; and
- (b) blocking structure in respective ones of said at least one channel, said blocking structure in a given said channel comprising first and second bands having respective lengths thereof, and extending along said channel structure, and restoration structure having restorative spring-like properties and extending between, the first and second bands, and urging the first and second bands into engagement with the first and second sides of the respective channel,

at least one of said first and second bands extending into a respective one of the apertures, said band being effective, as a consequence of driving a bone fastener through a respective one of the apertures, to respond to a side force applied by an interfering element of such bone fastener, by moving away from such interfering element, and by returning to a blocking position over the interfering element after such interfering element has passed said band,

whereafter the position of said band over the interfering element is effective to inhibit withdrawal of the bone fastener, past said band.

2. A spinal plate assembly as in Claim 1, said first and second bands comprising resiliently flexible bands, lengths of said bands extending alongside corresponding ones of the apertures whereby, as a such bone fastener is driven, a control structure of such bone fastener urges the respective said band to flex, from a first flexural condition, until such control structure in such bone fastener is driven past said band, whereupon said band resiliently returns from the flexed condition and overlies the control structure of the so-driven bone fastener and thereby inhibits the bone fastener withdrawing the control structure past the band.

3. A spinal plate assembly as in Claim 1, said channel structure extending along the length of said spinal plate past at least a first row of the apertures and opening into each of the bone-fastener-receiving apertures in the respective row.

4. A spinal plate assembly as in Claim 1 wherein all of said bone-fastener-receiving apertures comprise circular openings, and thus have substantially equal lengths and widths.

5. A spinal plate assembly as in Claim 1 wherein at least all except two of said bone-fastener-receiving apertures have greater lengths, along the length of said spinal plate, than widths transverse to the length of the spinal plate, and thereby comprise slots, all of said slots having commonly oriented axes along elongate dimensions of said slots, enabling longitudinal movement of bone fasteners in said slots, with respect to said spinal plate after said spinal plate assembly has been installed in a recipient user, thereby to accommodate settling of respective bones to which and/or adjacent which said spinal plate assembly is affixed.

6. A spinal plate assembly as in Claim 5 wherein all of said bone-fastener-receiving apertures comprise slots, all of said slots having commonly oriented axes along elongate dimensions of said slots.

7. A spinal plate assembly as in Claim 1, further comprising first and second rows of said bone-fastener-receiving apertures extending along the length of said spinal plate, said channel structure comprising a said channel extending along the length of said spinal plate, sides of said channel opening into respective ones of said apertures in the first and second rows of apertures, said first and second elongate bands being urged against the respective first and second sides of the channel, said first elongate band extending into and across portions of respective apertures in the first row, said second elongate band extending into and across portions of respective apertures in the second row.

8. A spinal plate assembly as in Claim 7 wherein said at least one restoration structure comprises at least two compression springs extending between said first and second bands.

9. A spinal plate assembly as in Claim 1 wherein said blocking structure comprises said first and second bands, and said restoration structure, said restoration structure comprising one or more compression springs extending between, and directly or indirectly interfacing with, said first and second bands.

10. A spinal plate assembly as in Claim 9 wherein said first and second bands, in combination with said compression springs, define a unitary structure derived from a single unitary work piece.

11. A spinal plate assembly as in Claim 7 wherein said first and second bands extend along substantially full lengths of respective first and second sides of the

channel, said first and second bands collectively extending into and across portions of each of the bone-fastener-receiving apertures.

12. A spinal plate assembly as in Claim 1, further comprising first and second rows of said bone-fastener-receiving apertures extending along the length of said spinal plate, said at least one channel comprising a said channel extending along the length of said spinal plate, and first and second overhanging top retaining walls of said channel extending inwardly from said sides of said channel, said overhanging top retaining walls being effective as retainers to restrain movement of said blocking structure out of said channel through the top of said channel.

13. A spinal plate assembly as in Claim 12, further comprising first and second band retainers extending from at least one of said first and second bands, each said band retainer on a respective said band extending inwardly toward the other said band, and at least one stud extending into said channel and interacting with said band retainers and said plate so as to prevent substantial longitudinal movement of said blocking structure along the length of said channel.

14. A spinal plate assembly as in Claim 12, said first and second elongate bands being urged, by said at least one restoration structure, against the respective first and second sides of the channel, and thus across a portion of each respective aperture in the first and second rows.

15. A spinal plate assembly as in Claim 13, said first and second bands being urged, by said at least one restoration structure, against the respective first and second sides of the channel, and thus into and across a portion of each respective aperture in the first and second rows.

16. A spinal plate assembly as in Claim 13, said first and second band retainers being spaced longitudinally from each other along the length of said

blocking structure, and interacting with first and second respective said studs, spaced from each other, the studs being disposed adjacent respective ones of said retainers so as to prevent substantial movement of said blocking structure along the length of said channel.

17. A spinal plate assembly as in Claim 13, said first and second band retainers being closely spaced longitudinally with respect to each other, and interacting with a common said stud, on opposing sides of said stud, so as to prevent substantial movement of said blocking structure along the length of said channel.

18. A spinal plate assembly as in Claim 1, said first and second bands extending alongside corresponding ones of the apertures whereby, as a such bone fastener is driven, a control structure of such bone fastener urges the respective said band to move from a first position transversely of the length of said band, with corresponding flexing of said at least one restoration structure, from a first flexural condition, until such control structure in such bone fastener moves past said band, whereupon said restoration structure returns said band to a position wherein said band overlies and blocks the control structure of the so-driven bone fastener and thereby inhibits the bone fastener withdrawing the control structure past said band.

19. A spinal plate assembly as in Claim 1 wherein said at least one restoration structure comprises at least two springs extending as compressible folded leaves between said first and second bands.

20. A spinal plate assembly as in Claim 1 wherein said first and second bands, and said at least one restoration structure, define a unitary structure derived from a single unitary work piece.

21. A spinal plate assembly as in Claim 19 wherein said first and second bands, and said at least one restoration structure, define a unitary structure derived from a single unitary work piece.

22. A spinal plate assembly as in Claim 1 wherein the compositions of said bands are selected from the group consisting of titanium, titanium alloy, and stainless steel.

23. A spinal plate assembly as in Claim 7 wherein the compositions of said bands are selected from the group consisting of titanium, titanium alloy, and stainless steel.

24. A spinal plate assembly as in Claim 1 wherein said bands are sufficiently small in cross-section, and are properly positioned over said apertures, so as to let such bone fastener pass below a respective said band, with transverse movement of said band, and without exceeding a flexural limit of said at least one restoration structure, such that said restoration structure then resiliently returns said band to a blocking position over such bone fastener.

25. A spinal plate assembly as in Claim 1 wherein said at least one restoration structure comprises a substantially straight line compression spring integral with said first and second bands, and wherein said spring, in combination with said first and second bands, defines a unitary structure derived from a unitary work piece.

26. A spinal plate assembly as in Claim 25, said at least one spring comprising at least three substantially straight line compression springs.

27. A spinal plate assembly as in Claim 1 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal

bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

28. A spinal plate assembly as in Claim 5 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

29. A spinal plate assembly as in Claim 6 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

30. A spinal plate assembly as in Claim 10 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

31. A spinal plate assembly as in Claim 20 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

32. A spinal plate assembly as in Claim 24 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal

bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

33. A spinal plate assembly as in Claim 26 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

34. A spinal plate assembly as in Claim 27 wherein the plastic composition of said blocking structure comprises one or more materials selected from the group consisting of polyetherimide copolymer, acetal copolymer, polyethersulfone, polyarylethersulfone, polycarbonate, ultra high molecular weight polyethylene, polyetheretherketone, and polyaryletherketone, and blends and mixtures of said materials.

35. A spinal plate assembly as in Claim 29 wherein the plastic composition of said blocking structure comprises one or more materials selected from the group consisting of polyetherimide copolymer, acetal copolymer, polyethersulfone, polyarylethersulfone, polycarbonate, ultra high molecular weight polyethylene, polyetheretherketone, and polyaryletherketone, and blends and mixtures of said materials.

36. A spinal plate assembly as in Claim 30 wherein the plastic composition of said blocking structure comprises one or more materials selected from the group consisting of polyetherimide copolymer, acetal copolymer, polyethersulfone, polyarylethersulfone, polycarbonate, ultra high molecular weight polyethylene, polyetheretherketone, and polyaryletherketone, and blends and mixtures of said materials.

37. A spinal plate assembly as in Claim 32 wherein the plastic composition of said blocking structure comprises one or more materials selected from the group consisting of polyetherimide copolymer, acetal copolymer, polyethersulfone, polyarylethersulfone, polycarbonate, ultra high molecular weight polyethylene, polyetheretherketone, and polyaryletherketone, and blends and mixtures of said materials.

38. A spinal plate assembly as in Claim 1 wherein said channel structure is expressed intermittently along the length of said plate.

39. A spinal plate assembly as in Claim 2 wherein said channel structure is expressed intermittently along the length of said plate.

40. A spinal plate assembly as in Claim 6 wherein said channel structure is expressed intermittently along the length of said plate.

41. A spinal plate assembly as in Claim 27 wherein said channel structure is expressed intermittently along the length of said plate.

42. A spinal plate assembly as in Claim 1 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.

43. A spinal plate assembly as in Claim 5 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.

44. A spinal plate assembly as in Claim 6 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.

45. A spinal plate assembly as in Claim 28 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.

46. A spinal plate assembly as in Claim 39 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.

47. A spinal plate assembly as in Claim 1 wherein the compositions of said first and second bands comprise at least one of titanium, titanium alloy, and stainless steel.

48. A spinal plate assembly as in Claim 6 wherein the compositions of said first and second bands comprise at least one of titanium, titanium alloy, and stainless steel.

49. A spinal plate assembly as in Claim 38 wherein the compositions of said first and second bands comprise at least one of titanium, titanium alloy, and stainless steel.

50. A spinal plate assembly as in Claim 1, said bone-fastener-receiving apertures being spaced along the length of said spinal plate, said channel structure comprising an elongate channel extending along the length of said spinal plate, said blocking structure comprising a plurality of band structures positioned in said channel, disposed lengthwise of each other, and disposed alongside respective ones

of said apertures, spacers being positioned between respective adjacent band structures so as to inhibit substantial longitudinal movement of said band structures.

51. A spinal plate assembly as in Claim 50, said spacers being held in position in said channel by studs extending through said spinal plate and into the channel, and into cooperating apertures in the respective said spacers.

52. A method of fabricating a spinal plate assembly, comprising:

- (a) providing a spinal plate having a top surface, a bottom surface opposite the top surface, the bottom surface being suitable for being positioned adjacent bone structure of a recipient user, and a plurality of bone-fastener-receiving apertures, the spinal plate further having a length and a width, and a thickness between the top surface and the bottom surface, and channel structure extending along the length of the spinal plate, the channel structure having a collective length, and first and second sides, at least one of the first and second sides of the channel structure having an opening therein extending into a respective one of the bone-fastener-receiving apertures, the channel having an opening on at least one end of the spinal plate;
- (b) inserting longitudinally into the channel, through the opening at the end of the spinal plate, a blocking structure, the blocking structure being effective, as a consequence of driving a bone fastener through a respective one of the apertures, to respond to a side force applied by an interfering element of such bone fastener, by moving away from such interfering element, and by returning to a blocking position over the interfering element after such interfering element has passed said blocking structure; and
- (c) locking the blocking structure in the channel.

53. A method as in Claim 52, the blocking structure having a length and comprising first and second bands connected to each other by a plurality of spaced resiliently compressible restoration structures, whereby the blocking structure is urged against a side wall of the channel structure.

54. A method as in Claim 52, the spinal plate defining first and second overhanging top walls of the channel, extending inwardly from the sides of the channel, the overhanging top walls being effective as band retainers to restrain movement of the blocking structure out of the channel through the top of the channel.

55. A method of installing a spinal plate assembly in a recipient user thereof, the method comprising:

- (a) providing, at the installation site in the recipient user, a spinal plate assembly comprising
  - (i) a spinal plate having a top surface, a bottom surface opposite the top surface, the bottom surface being suitable for being positioned adjacent bone structure of a recipient user, and a plurality of bone-fastener-receiving apertures, the spinal plate further comprising a length and a width, and a thickness between the top surface and the bottom surface, and channel structure extending along the length of the spinal plate, the channel structure having a collective length, and first and second sides, at least one of the first and second sides of the channel structure having an opening therein extending into a respective one of the bone-fastener-receiving apertures, the channel having an opening on at least one end of the spinal plate, and
  - (ii) blocking structure in the channel, the blocking structure comprising at least a first band extending along a side of the channel and being biased against at least one of the first and second sides of the channel, whereby the first band extends

across a portion of the respective bone-fastener-receiving aperture; and

- (b) advancing bone fasteners through selected ones of the bone-fastener-receiving apertures and into bone structure of such recipient user, including advancing interfering control structure of the bone fasteners past respective elements of the at least first band, such that a given interfering control structure of a respective fastener causes the at least first band to deflect from a first position, as the interfering control structure passes and such that, when the interfering control structure moves past the band, the band returns to the first position, thereby occupying a blocking position, whereby the blocking structure is effective to automatically interfere with withdrawal of the bone fastener past the band.

56. A spinal plate assembly, comprising:

- (a) a spinal plate, said spinal plate comprising a top surface, a bottom surface opposite the top surface, the bottom surface being suitable for being positioned adjacent bone structure of a recipient user, and a plurality of bone-fastener-receiving apertures, said spinal plate further having a length and a width, and a thickness between the top surface and the bottom surface, channel structure extending alongside respective ones of the apertures, said channel structure comprising at least one channel having a collective length, and first and second sides, at least one of the first and second sides of the at least one channel having an opening therein extending into a respective said bone-fastener-receiving aperture; and
- (b) blocking structure in respective ones of said at least one channel, said blocking structure in a given said channel having a length, and comprising at least a first band having a length, and extending along a side of the channel,

the band extending into a respective one of the apertures, said band being effective, as a consequence of driving a bone fastener through a respective one of the apertures, to respond to a side force applied by an interfering element of such bone fastener, by moving away from such interfering element, and by returning to a blocking position over the interfering element after such interfering element has passed said band,

whereafter the position of said band over the interfering element is effective to inhibit withdrawal of the bone fastener past said band.

57. A spinal plate assembly as in Claim 56 wherein said channel structure is expressed intermittently along the length of said plate.

58. A spinal plate assembly as in Claim 57 wherein all of said bone-fastener-receiving apertures have greater lengths, along the length of said spinal plate, than widths transverse to the length of the spinal plate, and thereby comprise slots, and wherein all of said slots have commonly oriented axes along elongate dimensions of said slots, enabling longitudinal movement of bone fasteners in said slots, with respect to said spinal plate after said spinal plate assembly has been installed in a recipient user, thereby to accommodate settling of respective bones to which and/or adjacent which said spinal plate assembly is affixed.

59. A spinal plate assembly as in Claim 56 wherein said blocking structure comprises a plastic composition which is safe for use in living human or animal bodies, as an implantable plastic, and which blocking structure has suitable strength, rigidity, and deflection properties to perform blocking functions in a routine implant use environment.

60. A spinal plate assembly as in Claim 56 wherein the plastic composition of said retaining structure comprises one or more materials selected from the group consisting of polyetherimide copolymer, acetal copolymer, polyethersulfone,

polyarylethersulfone, polycarbonate, ultra high molecular weight polyethylene, polyetheretherketone, and polyaryletherketone, and blends and mixtures of said materials.

61. A spinal plate assembly as in Claim 56 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.

62. A spinal plate assembly as in Claim 57 wherein the composition of said blocking structure comprises at least one of titanium, titanium alloy, and stainless steel.